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(56) Documents Cited
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INT CL[7] A01G 9/02 9/10

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(54) Abstract Title
Plant root container

(57) The container comprises a flexible strip of material 1 which has truncated cone recesses 6 formed therein. The recesses have an aperture 7 to guide roots to the outside of the container. The recesses correspondingly form protuberances on the external surface to of the strip 1 and these interlock so that the ends of the strip 10, 11 can form the container. The strip may form a cylindrical container that is fixed in place by a clip (fig 6) or other fastener. The container may have a base 18 which may be coated with a root-deterring substance 27. In use as the plant grows the strip can be unclipped to form a larger container.

FIGURE 2

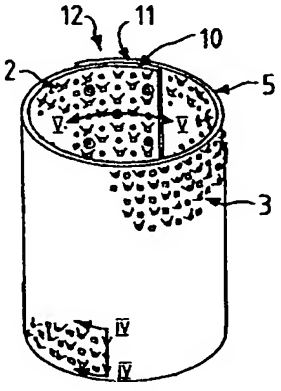
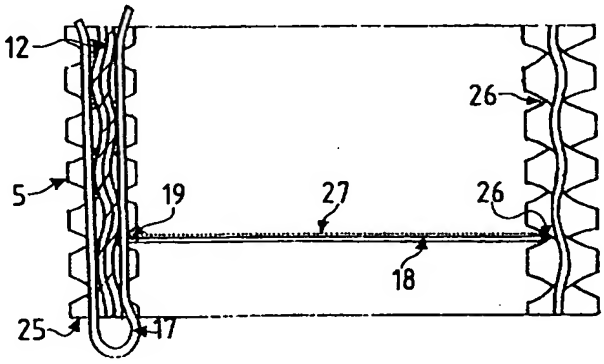


FIGURE 10



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DRAWINGS TO ACCOMPANY SPECIFICATION

FIGURE 1

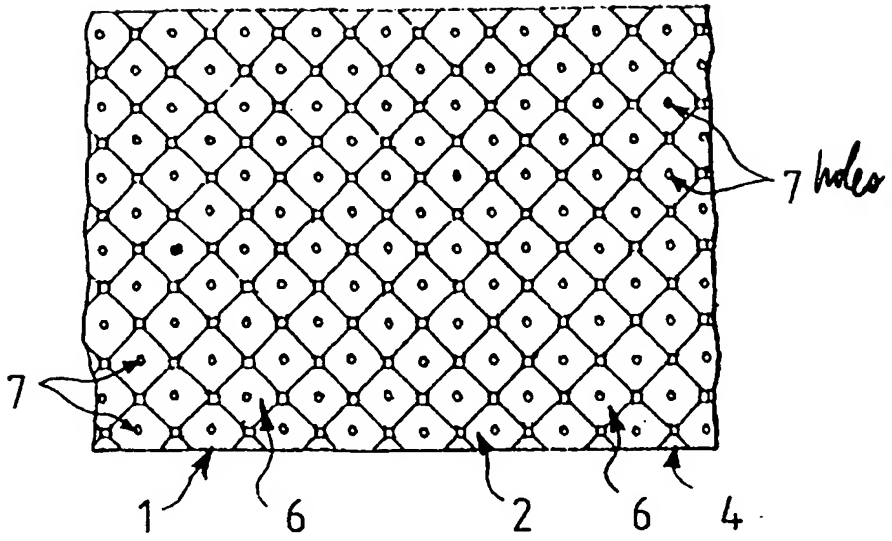


FIGURE 2

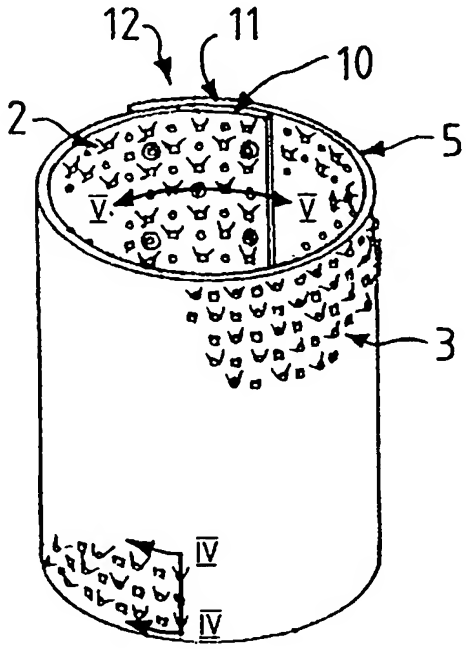


FIGURE 3

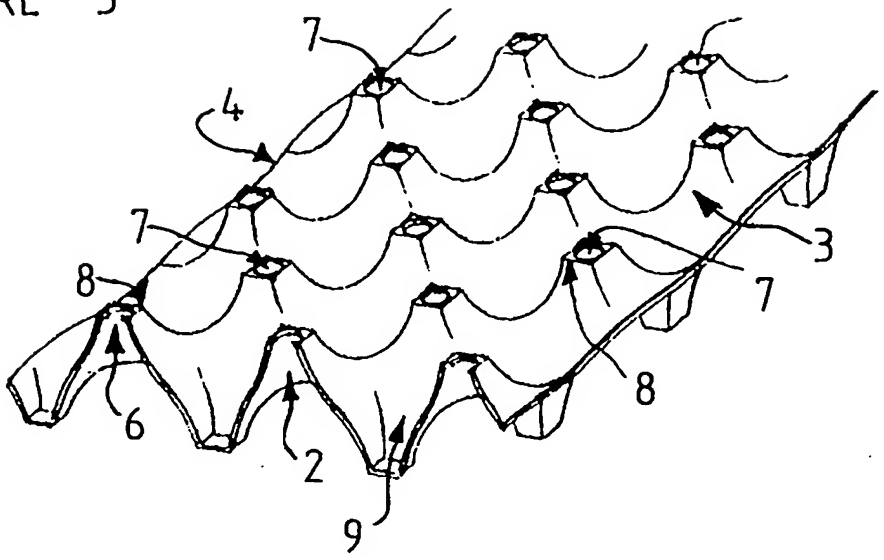


FIGURE 4

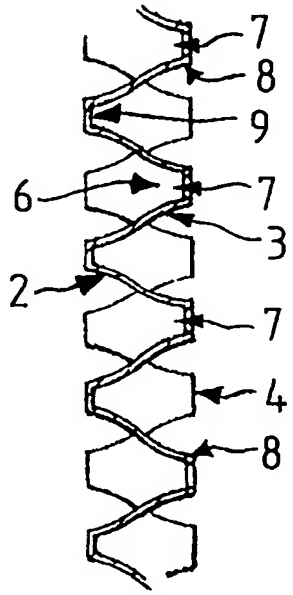


FIGURE 5

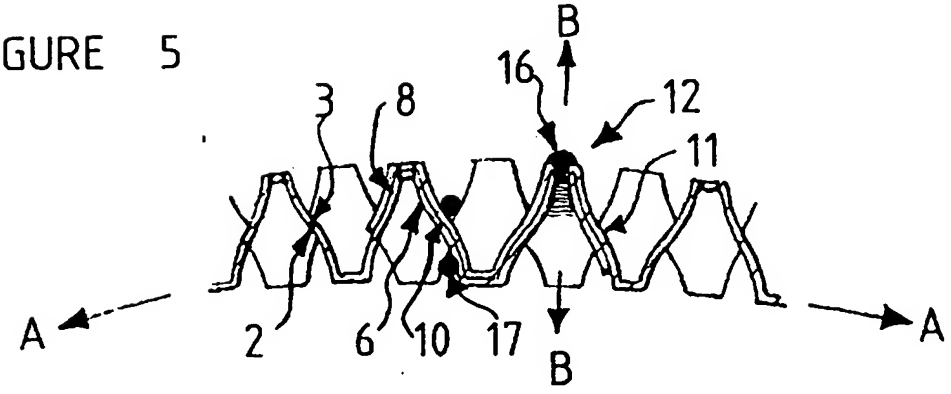


FIGURE 6

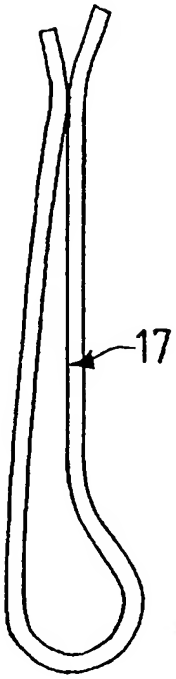


FIGURE 7

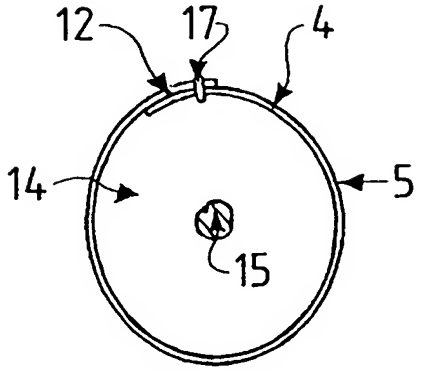


FIGURE 8

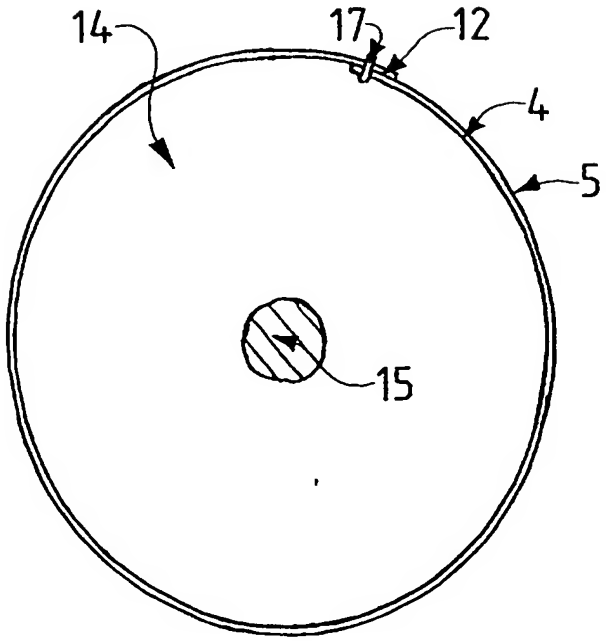


FIGURE 9

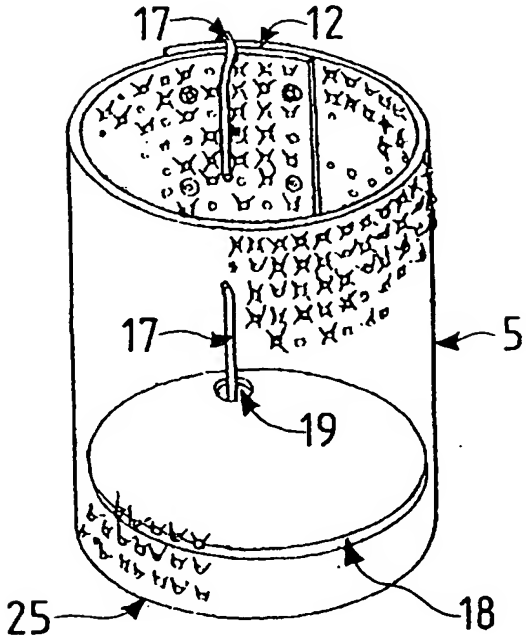


FIGURE 10

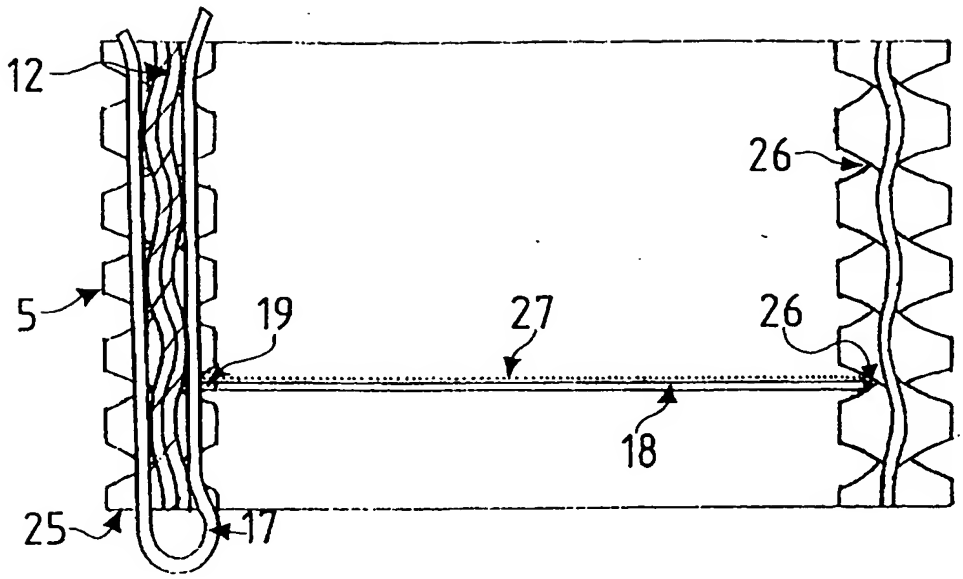


FIGURE 11

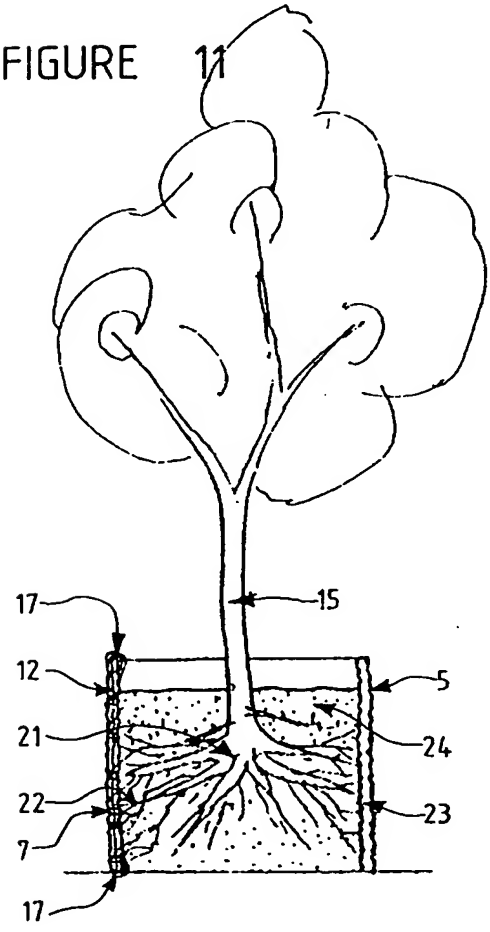
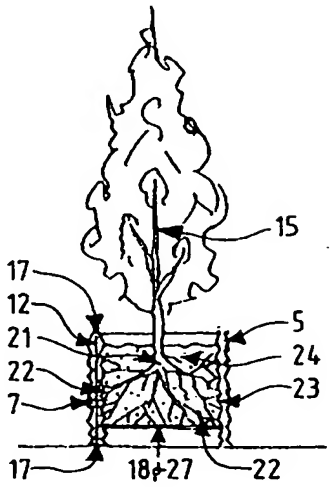


FIGURE 12



AIR ROOT PRUNING, PLANT PRODUCTION CONTAINER.

This invention relates to an air root pruning, plant production container, and more specifically, to containers suitable for growing plants which are to be transplanted into the ground at some future time.

The word "plant" as used throughout this specification is to be understood as embracing all forms of plant life, including trees, shrubs and other plant life grown for commercial sale, having a root structure which extends at least during the early stages of growth of the plant.

The first objective of the invention to provide a container for above ground plant growth which is easily adaptable in diameter, is reuseable and does not require a base.

The second objective of the invention to provide the container described in the first objective with a base adequate to support a load within the container. A further objective of the invention is to provide a base which controls the downward extension of the root growth of a plant within a container of this kind.

According to the first aspect of the invention a container is comprised of a flexible strip of material having a length greater than its width and having an inner and an outer surface, said inner surface being formed in part by a lattice of root guiding recesses or inner cusps, at least some of said recesses being of substantially truncated conical form having a wall which converges towards a hole through the strip, said outer surface being formed in part by a lattice of protruberances or outer cusps at the same relative positional arrangement as the recesses, said strip arranged in a cylinder with its opposite ends overlapping, nested engagement. It is further preferred that the side wall or side walls of the container be releasably connected so as to enable the container to be dismantled or adjusted to have a different lateral extent.

According to the second aspect of the invention a base can be provided which is suitable for use with a plant container, said base being capable of supporting a load within the container. In a preferred form, that base also functions to control the downward extension of root growth by coating the inside surface of said base with chemical growth retardant. It is further preferred that the base is releasably connected to the side wall or side walls of the container so as to enable the container to be dismantled.

The invention extends to a method of growing a plant using a container of the invention.

A particular feature of this container is the side wall arrangement which promotes air pruning of the expanding root structure. The arrangement is such that laterally extending roots are directed towards openings of restricted size formed through the container walls.

The root growth which extends to the openings is air pruned in a known manner, thus causing secondary roots to form. The secondary roots repeat the same growth and air pruning process. The arrangement of the invention in this form allows the container to be of variable diameter and volume.

Another feature of this container is to provide a base adequate to support a load situated within the container. This feature allows the container to be used within existing plant nursery operating procedures and to be readily transported with the load in place.

A further feature of this container is to provide a base which has been treated with a chemical growth retardant. Any root growth which extends down to the base is pruned by the copper based compound also causing secondary roots to form. These secondary roots repeat the same growth and chemical pruning process. This feature also allows the container to be used within existing plant nursery operating procedures and to be readily transported with the load in place.

The root system obtained from a container with or without a base, forms a well matted and cohesive root ball which is ideal for transplantation.

An embodiment of the invention is described in detail in the following passages of the specification which refer to the accompanying drawings. The drawings are however, merely illustrative of how the invention might be put into effect, so that the specific form and arrangement of the various features as shown is not to be understood as limiting on the invention.

In the drawings:

Figure 1 shows a side elevation view of a strip of material according to one aspect of the invention suitable for forming a container in which a plant may be grown;

Figure 2 shows a container of the type which is formed by a strip as shown in figure 1.

Figure 3 shows an enlarged perspective view of a portion of the strip of material shown in figure 1

Figure 4 shows a sectional view along line IV-IV of figure 2.

Figure 5 shows a sectional view along line V - V of figure 2.

Figure 6 shows a fastener Clip.

Figure 7 shows a plan view of the container shown in figure 2 with a smaller diameter, suitable for a base.

Figure 8 shows a container at a larger diameter for use without a base.

Figure 9 shows a perspective view of the container as shown in figure 7 with a base located near the bottom and the clip fixing.

Figure 10 shows a cross-section of the container as shown in figure 9 with a base located near the bottom and showing the chemical retardant application.

Figure 11 shows a side sectional view of a sapling growing in a container without a base according to the invention.

Figure 12 shows a side sectional view of a sapling growing in a container with a base according to the invention.

The present invention is particularly concerned with the growth of plants, such as trees and shrubs, in above ground containers prior to the plants being transplanted into the ground.

The main aims of the invention are:

- To provide containers of which guide primary roots radially outwardly towards holes in the container walls. As the roots approach the holes they are air pruned resulting in secondary roots branching from the length of the primary roots and thereby forming a well matted and cohesive root ball which is ideal for transplantation.

- To provide a base of various fixed diameters to the containers which allow free movement of the container during the production time of the plant and assist in promoting root development by chemically controlling downward root growth.

As shown in **Figures 1** and **2**, a strip *1* of material is shown having an inner surface *2* and an outer surface *3*. The strip is preferably formed of a relatively thin thermoplastic sheet material *4* which is rollable or bendable into a circular cylindrical container *5* as shown in **Figure 2**. The sheet material is sufficiently rigid and strong so that when formed into an open topped cylindrical container *5* as shown in **Figure 2**. the container *5* is self supporting and is able to be filled with a growing medium, such as soil or humus or the like.

The strip *1* has been plastically distorted or contoured as shown in **Figures 3** and **4** so as to provide a lattice of root guiding recesses *6* therein. The root guiding recesses each lead towards a hole *7* through the strip resulting in a lattice of holes *7* over the entire surface of the sheet. Any suitable recess *6* is substantially conically shaped tapering outwardly towards the respective hole *7* to which it leads. It is not essential that each recess *6* leads towards a respective hole *7*. but this is the preferred arrangement.

The sheet material *4* shown in **Figure 3** of the drawings depicts the form of the sheet in more detail. As shown, and as viewed from the outer surface side *3*, the sheet *4* is formed by distorting the sheet alternatively inwardly and outwardly in a grid pattern to form a grid of truncated conical peaks *8* and truncated conical recesses *9*, the peaks and recesses alternating in both the horizontal and vertical directions. Since the sheet *4* is thin, a peak *8* on the outer surface *3* will form a recess *6* on the inner surface *2*, and vice versa, and accordingly the form of the outer surface will be substantially inversely identical to the form of the inner surface. The tip of each peak *8* (as viewed from the outer surface) has been removed or slit to form the holes *7* through the sheet. Thus. when viewed from the inside, each recess *6* is of conical form and leads towards a hole *7* through the sheet.

Since the inner surface *2* is the inverse shape of the outer surface *3* the ends *10,11* of the strip *1* can be overlapped as shown in **Figure 2** so that, at the overlap *12*, the peaks *8* on the outer surface of one end *10* nest within the recesses 6 on the inner surface of the other end *11*.

When the ends *10,11* are in their overlapped condition, as shown in detail in **Figure 5**, a fastener will be provided to hold the two ends *10,11* in that engaged and overlapped condition. The fastener may comprise a rivet *16*, but if it is desirable to reuse, or expand the diameter of the container *5*, a releasable, sprung metal fastener clip *17* as shown in **Figure 6** may be provided or a strap or tie which passes through aligned holes *7* at the overlap could be used, or an adjustable strap or belt which extends around the circumference of the container *5* could be used for this purpose.

It will be appreciated that in plant containers a major stress component in the wall of the container is a tensile force which is depicted in **Figure 5** by arrows **B**. However, if the container *5* is to split at the overlap *12* the resistance to splitting as a result of the interlocking effect achieved by the interlocking of the two ends *10,11* will first need to be overcome. Due to the nesting outer and inner surface arrangement, the ends *10,11* will need to move apart in a direction transverse to the direction of arrows **A**. The tendency to move apart in this manner is resisted by the fastener *16*, or clip *17* and since there is a good interlocking effect achieved by the nesting arrangement the fastener *16* or clip *17* will not need to be particularly strong. Clearly, the greater the overlap the greater will be the interlocking effect and the more difficult it well be to split the container *5* at the overlap *12*.

The diameter of the container *5* will be selected according to requirements. It is envisaged that the sheet material *4* will be formed in long lengths in a continuous process, and the long lengths will cut to shorter lengths to form individual strips *1* for the containers *5*.

It is envisaged that for initial growing (i.e.. from seedling to the end of the first growing season) the strip will be rolled in a relatively tight roll around the inner volume *14* of the container *5* and base *18*, which may be as little as 0.5 Litres in volume, as depicted in **Figures 7** and **9** of the drawings. Thereafter in the second growing season the plant would be transferred or potted up into a container *5* the size which is determined by the producer who decides the size of both pot and plant required at sale.

It is further envisaged that the container may be formed with an impermeable base in the arrangement shown in **Figure 9**. In the arrangement shown, the base *18* is located within the tubular section of the container *5* and is retained in position by co-operation with the side wall. Since the side wall has a series of inwardly projecting cones or cusps *8* , *9* as shown in **Figure 10** a recess *26* is formed between each 2 adjacent rows. The edge of the base *18* is positioned within one such recess *26* so as to be elevated above the lower edge *25* of the container *5*. The base *18* is thereby supported by the cones or cusps *8*, *9* of the row which defines the lower boundary of the recess. The base *18* will be provided with a hole *19* as shown in **Figure 9** to permit the passage of one leg of the clip *17*.

In another arrangement the base *18* is coated, prior to insertion into the container *5* with a chemical growth retardant *27* as shown in **Figure 10**. The composition of the growth retardant does not form part of this invention. In this form the treated base *18, 27* is positioned within one such recess *26* so as to be elevated above the lower edge *25* of the container *5*. The base *18, 27* is thereby supported by the cones or cusps *8, 9* of the row which defines the lower boundary of the recess. The base *18, 27* will be provided with a hole *19* as shown in **Figure 9** to permit the passage of one leg of the clip *17*.

It is still further envisaged that the container be used to wrap up the root systems or root balls of plants dug up from the ground for the purpose of containerising or bringing them on above the ground as shown in **Figure 11** without the use of a base *18*. The strip *1* will be cut to a length that allows a significant overlap and wrapped closely to the diameter of the roots. As the root system develops within the container *5* the diameter can be expanded to enlarge the root ball . When the diameter of the container *5* is increased in this manner the added volume within the container will be filled with additional growing medium *24* which will add to the space in which roots within the container *5* can grow.

The size of the container can be increased as required until the ends *10, 11* are in a just overlapping configuration as depicted in **Figure 8** of the drawings. It will be appreciated that the container is capable of being fixed at almost any diameter. The tree is depicted in these drawings at numeral *15*.

Each time the size of the container *5* is increased the inner surface *2* of the container will be gently disengaged from the root tips and soil, the strip *1* will be unravelled to an extent, and then reconnected with the peaks on the outer surface nesting within the recesses of the inner surface of the overlapping ends. It will be appreciated that disconnection and reconnection will be simple to effect since the outer surface is the inverse shape of the inner surface and thus the two surfaces can be brought into proper engagement, in any position of diametrical adjustment, without any difficulty in manipulation or alignment.

As the two surfaces are brought together the cone shaped peaks and recesses will guide the two surfaces into proper face to face engagement. The clip *17* will then be used to hold the two surfaces in that engaged condition.

The strip *1* can be made from any suitable material although some form of thermoplastic material is considered optimum. It has also been found that a foamed polystyrene material could be used. Foamed polystyrene has heretofore been considered too soft and pliable to form air root pruning, plant production container,s. However, with the superior connection arrangement provided by the overlapping and interlocking ends *10,11* the resistance to shear at the overlap *12* is sufficiently great to allow for the use of this type of material.

Foamed polystyrene is also considered to be a suitable material because of its good heat insulation properties. It is envisaged that a foamed polystyrene material of between 2 and 3mm will be suitable for forming a container *5*.

The actual method of distorting the thermoplastics material does not form part of this invention. The sheet material shown in **Figures 3** to **5** can be formed by distorting a thermoplastic sheet, whilst it is plastically deformable, with two grids of opposed prongs thereby forming the alternating peaks and recesses on opposite sides of the sheet. The peak tips on the outer surface *3* can be removed by a grinding or sawing process to form the holes *7* through the sheet.

A tree *15* is shown growing in a container *5* in **Figure 11**. As will be evident, the root structure *21* of the tree *15* is well developed and substantial secondary root branching has occurred as a result of the air pruning of the root tips *22* as they grow to close to the holes *7* in the container wall *23*.

A tree *15* is shown growing in a container *5* in **Figure 12** which includes a base *18, 27*. As well as the primary and secondary root development *21* encouraged by the air pruning, primary and secondary root development also occurs as a result of the chemically treated base *18, 27*. The root structure *21* should hold the growing medium *24* within the container *5*.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A container for growing a plant comprised of a flexible strip of material having a length greater than its width and having an inner and an outer surface, said inner surface being formed in part by a lattice of root guiding recesses, at least some of said recesses being of substantially truncated conical form having a wall which converges towards a hole through the strip, said outer surface being formed in part by a lattice of protruberances at the same relative positional arrangement as the recesses. said strip arranged in a cylinder with its opposite ends overlapping and the protruberances on the outer surface of one end nesting within the recesses on the inner surface of the other end at the overlap, fastening means being provided to hold the strip in said overlapping, nested engagement.

2. A container according to claim 1 wherein said strip is formed of a relatively thin sheet of plastics material and the formation of said recesses in said inner surface produces said protruberances in said outer surface.

3. A container according to claim 1 or 2 wherein each recess leads towards a hole through said strip.

4. A strip of material for forming an open topped container within which a plant can be grown. said strip having a length greater than its width and an inner surface and an outer surface, the inner surface being formed in part by a lattice of root guiding recesses, at least some of said recesses being of substantially truncated conical form having a wall which converges towards a hole through the strip, the outer surface being formed in part by a lattice of protruberances at the same relative positional arrangement as the recesses, said strip being formed of a material which is sufficiently flexible so that strip can be rolled into a cylindrical form with opposite ends of the strip overlapping and the protruberances on the outer surface of one end nesting within the recesses on the inner surface of the other end.

5. A strip according to claim 4 wherein the material is a thin thermoplastic plastics material, the recesses on the inner surface forming the protruberances on the outer surface.

6. A strip according to claim 4 or 5 wherein each recess leads towards a hole through the strip.

7. A strip according to any one of claims 4 to 6 wherein the material from which the strip is made is a foamed polystyrene material.

8. A base suitable for use within the container according to claim 4, said base being capable of supporting a load within the container.

9. A base according to claim 8 wherein said base includes control means for controlling the downward extension of root growth of a plant.

10. A base according to claim 9 wherein said control means the application of a copper based ,chemical growth retardant

11. A base according to claim 8 wherein said base is adaptable for releasable connection to container according to claim 4.

12. A base according to claim 10 wherein said base is adaptable for releasable connection to container according to claim 4.

13. A method of growing a plant which is intended to be transplanted including the steps of providing a strip according to claim 4, rolling said strip into a cylindrical form to form a container of relatively small diameter, retaining said container in said rolled condition with a metal clip or adjustable fastening means, inserting a base according to clajms 11, 12, filling said container with growing medium and planting a plant in said growing medium, allowing said plant to grow for a selected period of time.

14. A method of growing a plant which is intended to be transplanted including the steps of providing a strip according to claim 4, rolling said strip into a cylindrical form to form a container of relatively large diameter, retaining said container in said rolled condition with a metal clip or adjustable fastening means, filling said container with growing medium and planting a plant in said growing medium, allowing said plant to grow for a selected period of time, releasing said fastening means, unrolling said strip to a degree to expand the diameter of said container, refitting the metal clip or refastening the fastening means, and filling the expanded container with additional growing medium, allowing said plant to grow for a further period of time.

15. A container substantially as hereinbefore described with reference to one of the embodiments shown in the drawings.

16. A strip of material substantially as hereinbefore described with reference to one of the embodiments depicted in the drawings.

17. A method of growing plants substantially as hereinbefore described with reference to the drawings.

DATED: 21 May 1997

Application No: GB 9710420.2
Claims searched: 1-17

Examiner: Paul Jenkins
Date of search: 19 September 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): A1E (EAKX)

Int Cl (Ed.7): A01G 9/02, 9/10

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	WO 97/00005 A1	(LAWTON) Whole document relevant	1-17
X	US 5099607	(LAWTON) Whole document relevant	1-17
X	AU 51865/93 A	(RONNEBY) Whole document relevant	1-17

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.